**Addressing Misconceptions in the Chemical Reactions Unit**

**Misconception #1.**

Students have difficulty with nomenclature, specifically with naming chemical compounds and using the cross-over rule.

**Addressing the Misconception:**

In order to really help students with naming compounds and understanding the cross-over rule to determine chemical formulas, the best suggestion is to get them to practice naming chemical compounds and writing out chemical formulas. The link below has an excellent summary for naming and writing formulas for ionic compounds.

<http://www.menihek.ca/Teacher%20Pages/Ruth%20Simmons_files/Namingandwritingformulasforioniccompounds.pdf>

Here is an example of an exit card or entry card students can complete in order to review nomenclature:

**Nomenclature Review:**

Write out the ***name*** for the following compounds:

1. NaCl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Na2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Ca3N2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. CaBr2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. NO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Write out the ***formula*** for the following compounds. (Show the cross-over method):

1. Calcium Chloride\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Aluminum Bromide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Lead Nitrate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Sodium Hydroxide\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Calcium Carbonate\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Cross-over rule:**

**The following example can be shown to students to display the crossover method:**

What is the name for Ca3N2?

|  |  |
| --- | --- |
| calcium ion | nitride ion |
| Ca2+ | N3- |
| calcium ~~ion~~ nitride~~ion~~ | |
| calcium nitride | |
| Ca3N2 | |

Ca2+ N3-

Ca3N2

**Answer Key:**

**Nomenclature Review:**

Write out the ***name*** for the following compounds:

1. NaCl sodium chloride
2. Na2O sodium oxide
3. Ca3N2  calcium nitride
4. CaBr2 calcium bromide
5. NO2  nitrogen dioxide

Write out the ***formula*** for the following compounds. (Show the cross-over method):

1. Calcium Chloride : CaCl2

Al3+  O2+

Al2O3

1. Aluminum Oxide: Al2O3
2. Lead (II) Nitrate: Pb(NO3)­2
3. Sodium Hydroxide: NaOH
4. Calcium Carbonate: CaCO3

**Misconception # 2:**

The reactants and products in chemical reactions can always be distinguished from one another.

**Addressing the misconception:**

Students can be shown the following example:

image0.png

This is the reaction that occurs when you light your natural gas range. Methane (natural gas) reacts with the oxygen in the atmosphere to produce carbon dioxide and water vapor. In this example, all of the reactants and products are gases and therefore cannot be distinguished from one another. However, the heat that is given off lets us know that the reaction is taking place. In addition, this example would be good to use because one cannot always see the products that are formed. Furthermore, the presence of a gas needs to be tested by using the splint test.

**Misconception # 3**

Students have difficulty differentiating between a chemical change and a change of state, which is when a physical change occurs. (Example dissolving and change of state cannot be classified as a chemical reaction).

**Addressing the Misconception:**

Need to make sure students understand that a chemical reaction involves creating something “new”. Therefore, the teacher could use “Concept Attainment.” It is an inductive process which allows students to construct concepts through searching for common characteristics. In this example students will compare “YES” examples of a chemical change with “NO” examples of a chemical change (which makes them physical changes). Students will then be presented with five testers that they need to either classify as being yes or no examples of chemical changes. This will help student’s differentiate between a chemical and physical change and should help them get rid of their misconception. Students should be able to derive the fact that the evidence for a chemical change is accounted by: changes in colour, production of a gas, formation of a precipitate, production or absorption of heat and production of light. )

**Activity: Concept Attainment**

|  |  |
| --- | --- |
| **YES Examples** | **NO Examples** |
| Lighting a match | Boiling water |
| A rusty tin can | Shredding a newspaper |
| Mixing copper sulfate and sodium hydroxide | Stretching an elastic band |
| Burning Toast | Dissolving salt in water |
| Copper roof turns green | Frost forms on a window |
| Adding magnesium metal to hydrochloric acid (followed by a gas test) | Cutting a carrot |

**Testers (Answers provided in red):**

1. Burning of magnesium metal (YES)
2. A can of pop fizzes (NO)
3. Boiling an egg (YES)
4. A tin can rusts (YES)
5. A popsicle freezes solid (NO)

**Misconception # 4**

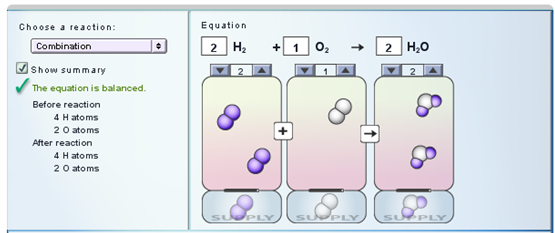
In a chemical reaction the mass is conserved, but not the number or species of atoms.

**Addressing the Misconception:**

Showing students the following gizmo on explorelearning.com (Chemical Reactions):

<http://www.explorelearning.com/index.cfm?method=cResource.dspView&ResourceID=408>

The gizmo is essentially used to illustrate balancing chemical equations. However, it also contains a visual representation of the individual atoms and will allow students to see that individual atoms or species do not change during a chemical reaction and stay the same. For example the 2 hydrogen atoms split up to form water when they are combined with oxygen, however, the actual hydrogen atom or species does not change and the number of atoms also stays the same. This gizmo should also be used when teaching students how to balance chemical equations.



**Misconception # 5.**

Chemical reactions must be driven by external intervention for example heat.

**Addressing the misconception:**

This is not true, external forces are not needed to drive a chemical reaction. A chemical reaction can occur simply by mixing two chemicals together. A demonstration with the chemicals silver nitrate and sodium chloride can be used to address this misconception. This is a good demo to use because after mixing these chemicals, a white precipitate forms indicating that a chemical reaction has occurred.

**Reaction:** AgNO3(aq) + NaCl(aq) 🡪 AgCl(s) + NaNO3(aq)

*Prior to Mixing*



*Post Mixing:*

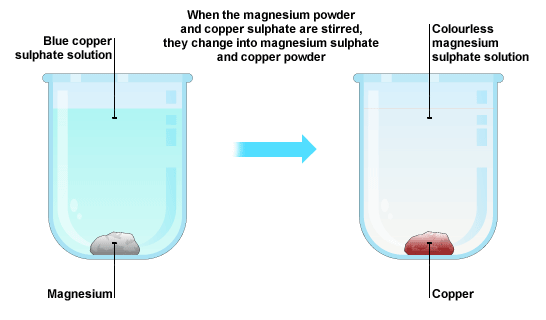


**Misconception # 6:**

Elements can form other elements.

**Addressing the misconception:**

Show students the following image and ask students what happens to magnesium ribbon. Several students might be tempted to say that the brown solid comes from the magnesium and somehow the magnesium turns into copper.



**Immediately after show students the following image:**

Need to ensure students understand that the magnesium has not disappeared and turned into copper but the fact that Mg2+ ions are still floating around in solution, and also that the magnesium simply displaces the copper in copper sulphate solution.

